(19) Europäisch s Pat ntamt
European Pat nt Office
Office uropé n des br v ts

(11) EP 0 560 324 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
19.08.1998 Bulletin 1998/34

(51) Int Cl.[6]: **C11D 3/39**, C11D 3/36, H01L 21/306

(21) Application number: **93103841.8**

(22) Date of filing: **10.03.1993**

(54) Cleaning fluid for semiconductor substrate

Reinigungsflüssigkeit für Halbleitersubstrate

Fluide de nettoyage pour substrat semi-conducteur

(84) Designated Contracting States:
DE FR GB

(30) Priority: **11.03.1992 JP 52580/92**
25.09.1992 JP 256718/92

(43) Date of publication of application:
15.09.1993 Bulletin 1993/37

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- **PATENT ABSTRACTS OF JAPAN vol. 14, no. 131 (C-700)1990**
- **DATABASE WPI Week 7507, Derwent Publications Ltd., London, GB; AN 75-11923W**
- **DATABASE WPIL Week 9251, Derwent Publications Ltd., London, GB; AN 92-422641**

Remarks:

The file contains technical information submitted after the application was filed and not included in this specification

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BACKGROUND OF THE INVENTION

(FIELD OF UTILIZATION IN INDUSTRY)

The present invention relates to a cleaning fluid for a semiconductor substrate. More particularly, the present invention relates to an improved cleaning fluid useful in cleaning a semiconductor substrate with a hydrogen peroxide cleaning fluid.

DESCRIPTION OF THE PRIOR ART & PROBLEMS THE PRESENT INVENTION AIMS TO SOLVE

In a fabrication process for fabricating a semiconductor device, semiconductor substrate such as silicon wafers are cleaned with chemicals in order to remove contaminant substances such as metals, organic substances, and fine particles attached on the surface thereof. As such a cleaning fluid, those containing hydrogen peroxide as a main ingredient are used frequently. There have been known, for example, a mixed aqueous solution containing hydrochloric acid and hydrogen peroxide, a mixed aqueous solution containing sulfuric acid and hydrogen peroxide, a mixed aqueous solution containing hydrofluoric acid and hydrogen peroxide, and a mixed aqueous solution containing ammonia and hydrogen peroxide.

In particular, a mixed aqueous solution containing ammonia and hydrogen peroxide which is basic in nature has been used most widely since it is effective in removing fine particles adhering on the surface of a substrate.

On the other hand, according as high integration of semiconductor proceeds, degree of cleanness of substrate surfaces is becoming much severer, which requires increase of cleaning power of cleaning fluids. As a matter of course, chemicals used in the cleaning fluid must be highly purified, and it is usual that metal impurities in each chemical must be controlled to 1 ppb or less. However, if cleaning was performed using such a highly purified chemical, in fact, adherence of a minute amount of a metal on the surface of a substrate has been inevitable due to contaminations from the environment, vessels, etc., and that of readherence of metals once removed from the substrate. Metals at stake are heavy metals such as iron, copper, and nickel. Adherence of these metals change the lifetime of minority carriers and cause lattice defects in the substrate, and therefore gives a great influence on the electrical properties of the semiconductor device. In particular, iron adheres strongly to a substrate in a basic cleaning fluid such as a mixed aqueous solution of ammonia and hydrogen peroxide, and has been at stake. While with an acidic cleaning fluid the amount of a metal adhering to the substrate decreases, copper still tends to adhere in a mixed aqueous solution of hydrofluoric acid and hydrogen peroxide, which causes a problem.

As described above, since trace amount of metals adhering on the surface of the substrate gives an adverse influence on the electrical properties of a semiconductor device, that amount must be as small as possible, and it is pointed out that nowadays when high integration of semiconductor devices have already proceeded considerably, the amount of metals adhering must be as low as below lower limit of detection of a TREX (Total Reflection Energy Dispersive X-ray Fluorescence) apparatus widely used in a analysis of the amount of adhering metals.

DE-A-3822350 described attempts to decrease the amount of adhering metal impurities by the addition of an additive to a hydrogen peroxide cleaning fluid. In the publication, the addition of ethylenediaminetetracarboxylic acid (ETDA), which is a chelating agent, is proposed. In fact, however, the addition of EDTA gave almost no effect. In contrast, the present inventors found that some phosphonic acid chelating agents are effective for suppressing the adherence of metals as described in Japanese Patent Application No. 55736/1991. The addition of such a phosphonic acid chelating agent decreases the amount of adhering metals considerably to thereby improve the yield of fabrication of semiconductor devices greatly. However, even the addition of the phosphonic acid chelating agent failed to achieve suppression of the adherence of metals to a level of at most 1×10^{10} atoms/cm^2. Therefore, there has been a keen desire for an improve countermeasure.

GB-A-2 072 643 discloses an aqueous bleach composition which includes hydrogen peroxide, ethanol and amino compounds which are substituted by acetate or methylene phosphonates and hydroxyalkyl diphosphonates.

WO-A-93/13012, which is a document within the meaning of Art. 54(3) EPC, discloses a bleach composition which includes alkaline hydrogen peroxide, disodium tetraborate decahydrate and cyclohexane-1,2-diaminotetramethylene phosphonic acid.

EP-A-0 276 774 discloses a semiconductor cleaning solution which includes hydrogen peroxide, sulfuric acid, a sequestrant such as phosphonic acid, and a surfactant.

DE-A-3 215 966 discloses a cleaning fluid which includes ammonia and hydrogen peroxide.

SUMMARY OF THE INVENTION

The present inventors have made extensive investigation with view to obtaining a novel hydrogen peroxide cleaning fluid for cleaning semiconductor substrates which fluid gives an amount of metals adhering on the surface of a substrate is at most 1 x 10^{10} atoms/cm^2. As a result, they have now found that a cleaning fluid containing a wetting agent which improves the wetness of the cleaning fluid to the surface of a substrate in addition to a phosphonic acid chelating agent can decrease the amount of metals adhering to the surface of the substrate to a level of at most 1 x 10^{10} atoms/cm^2. On the other hand, they also have found that although simultaneous use of a phosphonic acid chelating agent and a wetting agent can decrease the amount of metals adhering on the surface of the substrate to a level of at most 1 x 10^{10} atoms/cm^2, the use of a surfactant as the wetting agent will lead to problems of foamability of the cleaning fluid and adherence and retention of the surfactant on the surface of the substrate.

That is, the adherence of the surfactant to the substrate is ascribable to hydrophobic groups (oleophilic groups) of the surfactant, and generally the greater the proportion of the hydrophobic groups, the stronger their adherence to the substrate. The adhering surfactant could not be removed completely by subsequent rinsing with ultrapure water, and becomes a cause of forming silicon carbide in the step of oxidation of the substrate. Formation of silicon carbide gives an adverse influence on the electrical properties of a semiconductor device, for example, deteriorating pressure resistance of oxide film.

The present inventors have now found that among the wetting agents, in particular polyhydric alcohols represented by general formula (I) below

$$HOCH_2\text{-}(CHOH)n\text{-}CH_2OH \ (n = 0 \text{ to } 10) \qquad (I)$$

or its oxidant have high hydrophilicities and can readily be removed with ultraDure water, and hence they cause no problem of their adherence and retention on the surface of a substrate, and also that they are wetting agents which can solve the problem of forming upon cleaning since they give less foaming at the time of cleaning substrates, and the use of them wetness of the cleaning fluid increases greatly, thus strengthening the cleaning power of the cleaning fluid. That is, a first object of the present invention it to provide a novel hydrogen peroxide cleaning fluid for semiconductor substrates which can decrease the amount of metals adhering on the surface of a substrate after cleaning to a level of at most 1 x 10^{10} atoms/cm^2.

A second object of the present invention is to provide a novel hydrogen peroxide cleaning fluid for semiconductor substrates which has a good wetting agent and is free of retention of a wetting agent in the cleaning fluid on the surface of a substrate.

Further, a third object of the present invention is to provide a novel hydrogen peroxide cleaning fluid for semiconductor substrates which is free of retention of a wetting agent in the cleaning fluid on the surface of a substrate, causes less foaming at the time of cleaning, and has an excellent ability of removing particulates on the substrate.

DETAILED DESCRIPTION OF THE INVENTION

That is, the present invention provides a cleaning fluid composition for cleaning a semiconductor substrate, comprising

(a) 0.1 to 30 wt.-% of a hydrogen peroxide,
(b) 0.1 to 10 wt.-% of a base selected from the group consisting of ammonia, hydroxyltrimethylammonium hydroxide and tetramethylammonium hydroxide,
(c) a wetting agent selected from the group consisting of anionic surfactants, cationic surfactants, nonionic surfactants, fluorinated surfactants, a water-soluble organic additive that can improve the wetness of a cleaning agent on the surface of the substrate, in an amount of 1 to 15,000 ppm based on the cleaning fluid, and
(d) a phosphoric acid chelating agent in an amount of 1 ppb to 1,000 ppm based on the amount of the cleaning fluid.

Now, the present invention will be described in detail hereinbelow. First, the phosphonic acid chelatinq agent to be used according to the invention is not limited particularly so far as it is a chelating agent having at least two phosphonic acid groups. Representative examples of such a chelating agent includes aminotri(methylenephosphonic acid), 1-hydroxyethylidene-1,1-diphosphonic acid, ethylenediaminetetra(methylenephosphonic acid), hexamethylenediaminetetra(methylenephosphonic acid), propylenediaminetetra(methylenephosphonic acid), di thylenetriaminepenta (methylenephosphonic acid), triethylenetetraminehexa(methylenephosphonic acid), triaminotriethylaminehexa(methylenephosphonic acid), trans-1,2-cyclohexanediaminetetra(methylenephosphonic acid), glycol ether diaminetetra

(methylenephosphonic acid), and tetraethylenepentaminehepta(methylenephosphonic acid). These chelating agents which can be used in the present invention may be used preferably in the form of free acid. However, they may also be used in the form of salt such as ammonium salt or the like when they have insufficient solubilities.

The amount of the phosphonic acid chelating agent is 1 ppb to 1,000 ppm based on total amount of the cleaning fluid. The phosphonic acid chelating agent may be added to a cleaning fluid which has been prepared in advance, or it may be added to one or more of hydrogen peroxide, water, ammonia or organic amines, in advance followed by mixing these components to prepare a cleaning fluid.

Next, examples of the wetting agent which can be used in the present invention include anionic surfactants such as sulfonic acid surfactants, sulfate surfactants, phosphate surfactants, fatty acid surfactants, and polycarboxylic acid surfactants; cationic surfactants such as amine surfactants, and quaternary ammonium salt surfactants; and nonionic surfactants such as ethylene oxide added surfactants, ethylene oxide propylene oxide copolymer surfactants, and glycerol ester surfactants. Also, there may be used fluorinated surfactants obtained by partially fluorinating the aforementioned surfactants. Further, any water-soluble organic additives that can improve the wetness of a cleaning agent on the surface of a substrate may be used as a wetting agent in the present invention.

Specific examples of the water-soluble organic additive which can be used as a wetting agent in the present invention include alcohols such as ethanol, isopropanol, triethylene glycol monomethyl ether, and triethylene glycol monoethyl ether; glycols such as ethylene glycol, and propylene glycol; carboxylic acids such as acetic acid, propionic acid, and enanthic acid; hydroxycarboxylic acids such as glycolic acid, tartaric acid, and citric acid; polycarboxylic acids such as polyacrylic acid, Dolymethacrylic acid, polymaleic acid, and copolymerizate thereof; and polyhydric alcohols such as glycerol, sorbitol, and polyvinyl alcohol, or their oxidants.

Of these wetting agents, particularly preferred ones are polyhydric alcohols reDresented by general formula (I)

$$HOCH_2\text{-}(CHOH)n\text{-}CH_2OH \ (n = 0 \text{ to } 10) \qquad (I)$$

or their oxidized substances.

Specific examples of such polyhydric alcohol include ethylene glycol, glyerol, erythritol, xylitol, sorbitol and mannitol.

The oxidized substances of the polyhydric alcohols are those obtained by substituting one or both terminal $-CH_2OH$ groups of the polyhydric alcohol represented by general formula (I) with a -CHO group or a -COOH group. Specific examples thereof include glycol aldehyde, glycolic acid, glyoxal, oxalic acid, glyceric acid, glucose and tartaric acid.

Further, the oxidized substances of the polyhydric alcohols include those obtained by substituting a part or all of -CHOH- groups in the polyhydric alcohol represented by general formula (I) with a -CO- group. Specific examples thereof include dioxyacetone and fructose.

While the content of the wetting agent is not limited particularly, it is preferred that the wetting agent is contained in a cleaning fluid in such a concentration that the surface tension of the cleaning fluid is 60 dyne/cm or less, or the contact angle of the cleaning fluid to the surface of a substrate is 50° or less.

The content of the wetting agent is 1 to 15,000 ppm based on the cleaning fluid.

The wetting agent may be added to a cleaning fluid which has been prepared in advance, or it may be added to one or more of hydrogen peroxide, water, ammonia and organic amines in advance followed by mixing these components to prepare a cleaning fluid.

Also, two or more wetting agents may be used in combination.

In the cleaning fluid for cleaning semiconductor substrates according to the present invention, a mixed aqueous solution of ammonia and hydrogen peroxide which contains a phosphonic acid chelating agent and a wetting agent has particularly improved cleaning action for semiconductor substrates.

Further, the cleaning fluid for cleaning semiconductor substrates according to the present invention includes those solutions obtained by adding a phosphonic acid chelating agent and a wetting agent to a mixed aqueous solution containing choline (hydroxyltrimethylammonium hydroxide) and hydrogen peroxide and a mixed aqueous solution containing TMAH (tetramethylammonium hydroxide) and hydrogen peroxide.

EFFECT OF THE INVENTION

The use of the cleaning fluid for cleaning semiconductor substrates according to the present invention enables effective cleaning of semiconductor substrates such that the amount of metals adhering to the surface of a substrate is at most 1×10^{10} atoms/cm^2.

In the case where the polyhydric alcohols represented by general formula (I) or th ir oxidized substances are used as a wetting agent, the wetness of the cleaning fluid to the surface of a semiconductor substrate is improved, and the polyhydric alcohols or their oxidized substances will not adhere nor remain on the surface of the substrate, and hence

semiconductor devices derived from the semiconductor substrates cleaned by the use of such a cleaning fluid will be free from advers effects on electrical properties that will be otherwise encountered when the substrates cleaned with the conventional cleaning fluids.

The cleaning fluid of the present invention has similar excellent effects for cleaning semiconductor devices with substrates on which circuits have been formed.

EXAMPLES

Hereinafter, the present invention will be described in more detail by an example.

Example 1

High purity ammonia (28% by weight), high purity hydrogen peroxide (30% by weight) and ultrapure water were mixed in proportions of 1 : 4 : 20 by weight, and one or more additives shown in Table 1 were added to the resulting mixture to prepare a cleaning fluid. A precleaned silicon substrate of 7.6 cm (3 inches) in diameter was dipped in the cleaning fluid thus obtained at 85°C for 10 minutes for cleaning. After rinsed with ultrapure water, the substrate was air-dried. This was examined for analysis of the amount of iron or copper adhering thereto by using TREX (Total Reflection Energy Dispersive X-ray fluorescence). At the same time, surface tension of the cleaning fluid at 85°C and contact angle of the cleaning fluid to the substrate were measured. Further, the contents of iron and copper, respectively, in the cleaning fluid just after the preparation were determined by atomic absorption spectroscopy. Here, Tensiometer Type CBVP-A3 (Wilhelmy's method, KYOWA KAIMEN KAGAKU Co., Ltd.) was used for the measurement of surface tension. Contact angle was measured using a contact angle measuring instrument Type CA-D (Liquid drop method, KYOWA KAIMEN KAGAKU Co., Ltd.) in a state after 10 seconds from the dropping of a liquid. Results obtained are shown in Table 1.

Table 1

Test No.	Additive	Amount of Metal in Cleaning Fluid Fe (ppb)	Cu (ppb)	Surface Tension of Cleaning Fluid (dyne/cm)	Contact Angle of Cleaning Fluid (degree)	Amount of Metal Adhering to Substrate (10^{10} atoms/cm^2) Fe	Cu
(1)	None	0.4	0.1	65	59	120	5
(2)	EDTMP 10 ppb	0.4	0.1	64	59	5	3
(3)	EDTMP 10 ppm	0.4	0.1	65	58	4	3
(4)	EDTMP 10 ppb ABSA 100 ppm	0.6	0.2	61	<5	<1	<1
(5)	EDTMP 10 ppb ABSA 10 ppm	0.5	0.1	62	51	3	2
(6)	EDTMP 10 ppm PAA 100 ppm	0.7	0.1	60	49	<1	<1

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Table 1 (continued)

Test No.	Additive	Amount of Metal in Cleaning Fluid Fe (ppb)	Cu (ppb)	Surface Tension of Cleaning Fluid (dyne/cm)	Contact Angle of Cleaning Fluid (degree)	Amount of Metal Adhering to Substrate (10^{10} atoms/cm^2) Fe	Cu
(7)	EDTMP 10 ppm 2-EHD 500 ppm	0.5	0.1	58	45	<1	<1
(8)	2-EHD 500 ppm	0.5	0.1	58	44	95	4
(9)	PDTMP 10 ppb	0.4	0.1	65	58	1	2
(10)	PDTMP 10 ppb EG 100 ppm	0.4	0.1	63	20	<1	<1
(11)	PDTMP 10 ppb GA 500 ppm	0.5	0.1	62	31	<1	<1

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Table 1 (continued)

Test No.	Additive	Amount of Metal in Cleaning Fluid Fe (ppb)	Cu (ppb)	Surface Tension of Cleaning Fluid (dyne/cm)	Contact Angle of Cleaning Fluid (degree)	Amount of Metal Adhering to Substrate (10^{10} atoms/cm^2) Fe	Cu
(12)	PDTMP 10 ppb Glycol 500 ppm	0.5	0.1	61	22	<1	<1
(13)	PDTMP 10 ppb Sorbitol 500 ppm	0.6	0.1	63	34	<1	<1
(14)	DETMP 10 ppm ABSA 100 ppm	0.7	0.1	60	<5	<1	<1

Notes:

In Table 1, EDTMP designates ethylenediaminetetra(methylenephosphonic acid), PDTMP propylenetriaminetetra(methylenephosphonic acid), DETMP diethylenediaminepenta(methylenephosphonic acid), ABSA alkylbenzenesulfonic acid, PAA polyacrylic acid, 2-EHD 2-ethyl-1,3-hexanediol, EG ethylene glycol, and GA glycolic acid. As the alkylbenzenesulfonic acid and polyacrylic acid, there were used LIPON® LH-500, LION Co., Ltd. and POIZ® 520, KAO Co., Ltd., respectively.

Test Nos. 1, 2, 3, 8 and 9 were for comparison.

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Claim

1. A cleaning fluid composition for cleaning a semiconductor substrate, comprising

   (a) 0.1 to 30 wt.-% of a hydrogen peroxide,
   (b) 0.1 to 10 wt.-% of a base selected from the group consisting of ammonia, hydroxyltrimethylammonium hydroxide and tetramethylammonium hydroxide,
   (c) a wetting agent selected from the group consisting of anionic surfactants, cationic surfactants, nonionic surfactants, fluorinated surfactants, a water-soluble organic additive that can improve the wetness of a cleaning agent on the surface of the substrate, in an amount of 1 to 15,000 ppm based on the cleaning fluid, and
   (d) a phosphonic acid chelating agent in an amount of 1 ppb to 1,000 ppm based on the amount of the cleaning fluid.

2. The cleaning fluid for cleaning a semiconductor substrate as claimed in claim 1, wherein said wetting agent is a sulfonic acid surfactant.

3. The cleaning fluid for cleaning a semiconductor substrate as claimed in claim 1, wherein said wetting agent is an ethylene oxide-added nonionic surfactant.

4. The cleaning fluid for cleaning a semiconductor substrate as claimed in claim 1, wherein said wetting agent is a polycarboxylic acid or its copolymerization modified product.

5. The cleaning fluid for cleaning a semiconductor substrate as claimed in claim 1, wherein said wetting agent is a polyhydric alcohol represented by general formula (I)

$$HOCH_2\text{-}(CHOH)_nCH_2OH \ (n = 0 \text{ to } 10) \qquad (I)$$

   or its oxidized substance.

6. The cleaning fluid for cleaning a semiconductor substrate as claimed in claim 1, wherein said wetting agent is at least one member selected from the group consisting of ethylene glycol, glycerol, glycolic acid, erythritol, xylitol, and mannitol.

7. The cleaning fluid for cleaning a semiconductor substrate as claimed in claim 1, wherein said phosphonic acid chelating agent is a member selected from the group consisting of propylenediaminetetra(methylenephosphonic acid), ethylenediaminetetra(methylenephosphonic acid), and diethylenetriaminepenta (methylenephosphonic acid).

Patentansprüche

1. Reinigungsflüssigkeit bzw. -mittel für die Reinigung eines Halbleitersubstrats, umfassend

   (a) 0,1 bis 30 Gew.-% eines Wasserstoffperoxids,

   (b) 0,1 bis 10 Gew.-% einer Base, ausgewählt aus der Gruppe bestehend aus Ammoniak, Hydroxyltrimethylammoniumhydroxid und Tetramethylammoniumhydroxid,

   (c) ein Netzmittel, ausgewählt aus der Gruppe bestehend aus anionischen Tensiden, kationischen Tensiden, nichtionischen Tensiden, fluorierten Tensiden, einem wasserlöslichen organischen Additiv, welches die Netzfähigkeit eines Reinigungsmittels auf der Oberfläche des Substrats verbessern kann, in einer Menge von 1 bis 15.000 ppm, bezogen auf das Reinigungsmittel, und

   (d) in Phosphonsäure-Chelatbildn r in einer Menge von 1 ppb bis 1.000 ppm, bezogen auf die Menge des Reinigungsmittels.

2. Reinigungsmittel zur Reinigung eines Halbleitersubstrats nach Anspruch 1, dadurch gekennzeichnet, daß das Netzmittel ein Sulfonsäure-Tensid ist.

3. Reinigungsmittel zur Reinigung eines Halbleitersubstrats nach Anspruch 1, dadurch gekennzeichnet, daß das Netzmittel ein nichtionisches Ethylenoxid-versetztes Tensid ist.

4. Reinigungsmittel zur Reinigung eines Halbleitersubstrats nach Anspruch 1, dadurch gekennzeichnet, daß das Netzmittel eine Polycarbonsäure oder ein durch Copolymerisation modifiziertes Produkt davon ist.

5. Reinigungsmittel zur Reinigung eines Halbleitersubstrats nach Anspruch 1, dadurch gekennzeichnet, daß das Netzmittel ein mehrwertiger Alkohol der allgemeinen Formel (I)

$$HOCH_2\text{-}(CHOH)_n\text{-}CH2OH \ (n = 0 \text{ bis } 10) \qquad (I)$$

oder ein Oxidationsprodukt davon ist.

6. Reinigungsmittel zur Reinigung eines Halbleitersubstrats nach Anspruch 1, dadurch gekennzeichnet, daß das Netzmittel mindestens eine Verbindung aus der Gruppe bestehend aus Ethylenglykol, Glycerin, Glykolsäure, Erythrit, Xylit und Mannit ist.

7. Reinigungsmittel zur Reinigung eines Halbleitersubstrats nach Anspruch 1, dadurch gekennzeichnet, daß der Phosphonsäure-Chelatbildner eine Verbindung, ausgewählt aus der Gruppe bestehend aus Propylendiamintetra (methylenphosphonsäure), Ethylendiamintetra(methylenphosphonsäure) und Diethylentriaminpenta (methylenphosphonsäure) ist.

Revendications

1. Composition de fluide nettoyant pour nettoyer un substrat semi-conducteur, comprenant

(a) 0,1 à 30% en poids de peroxyde d'hydrogène,
(b) 0,1 à 10% en poids d'une base choisie dans le groupe formé par l'ammoniac, l'hydroxyde d'hydroxyltriméthylammonium et l'hydroxyde de tétraméthylammonium,
(c) un agent mouillant choisi dans le groupe formé par les tensio-actifs anioniques, les tensio-actifs cationiques, les tensio-actifs non ioniques, les tensio-actifs fluorés, un additif organique hydrosoluble qui peut améliorer la mouillabilité d'un agent nettoyant sur la surface du substrat, en une quantité de 1 à 15 000 ppm par rapport au fluide nettoyant, et
(d) un agent chélatant à l'acide phosphonique en une quantité de 1 ppb à 1 000 ppm par rapport à la quantité du fluide nettoyant.

2. Fluide nettoyant pour nettoyer un substrat semiconducteur selon la revendication 1, dans lequel ledit agent mouillant est un tensio-actif à base d'acide sulfonique.

3. Fluide nettoyant pour nettoyer un substrat semiconducteur selon la revendication 1, dans lequel ledit agent mouillant est un tensio-actif non ionique à base d'oxyde d'éthylène ajouté.

4. Fluide nettoyant pour nettoyer un substrat semiconducteur selon la revendication 1, dans lequel ledit agent mouillant est un acide polycarboxylique ou son produit modifié par copolymérisation.

5. Fluide nettoyant pour nettoyer un substrat semiconducteur selon la revendication 1, dans lequel ledit agent mouillant est un polyol représenté par la formule générale (I)

$$HOCH_2\text{-}(CHOH)_nCH_2OH \ (n = 1 \text{ à } 10) \qquad (I)$$

ou sa substance oxydée.

6. Fluide nettoyant pour nettoyer un substrat semiconducteur selon la revendication 1, dans lequel ledit agent mouillant est au moins un élément choisi dans le groupe formé par l'éthylèneglycol, le glycérol, l'acide glycolique, l'érythritol, le xylitol et le mannitol.

7. Fluide nettoyant pour nettoyer un substrat semiconducteur selon la revendication 1, dans lequel ledit agent chélatant à base d'acide phosphonique est un élément choisi dans le groupe formé par l'acide propylènediaminetétra (méthylènephosphonique), l'acide éthylènediaminetétra (méthylènephosphonique) et l'acide diéthylènetriaminepenta (méthylènephosphonique).